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Kageyama et al.

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(54) **AIRTIGHT CAP STRUCTURE**

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(51) **Int. Cl.**
B43K 5/00 (2006.01)

(52) **U.S. Cl.** **401/202**; 401/243

(58) **Field of Classification Search** 401/107, 401/108, 202, 213, 243–248
See application file for complete search history.

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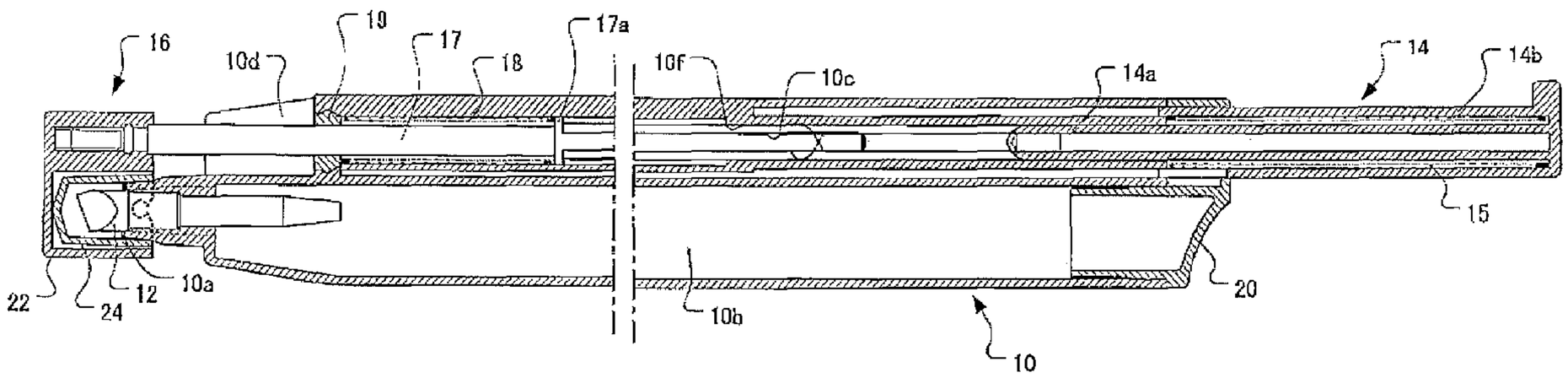
(57) **ABSTRACT**

A airtight cap structure is capable of coming into close contact with a tip to be used and securing airtightness, even if the tip might be inserted in the cap with having a relative angle or offset between the cap and the tip. A cap comprises an outer cap and an inner cap arranged in the outer cap. The inner cap is mounted to the outer cap so that the inner cap can incline relative to the central axial line of the cap, and the cap comes into close contact with the tip or its periphery when the cap covers the tip.

7 Claims, 13 Drawing Sheets



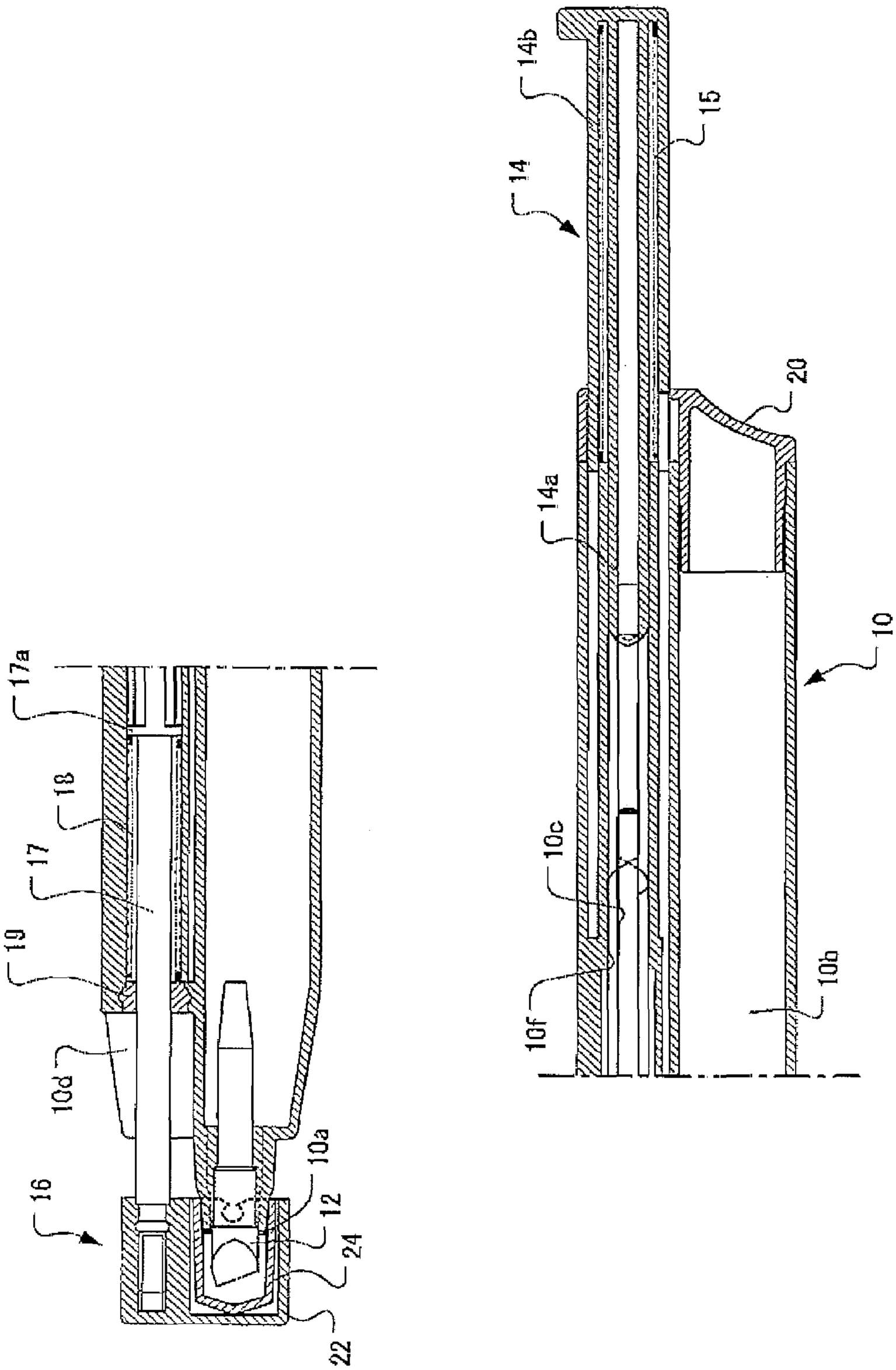
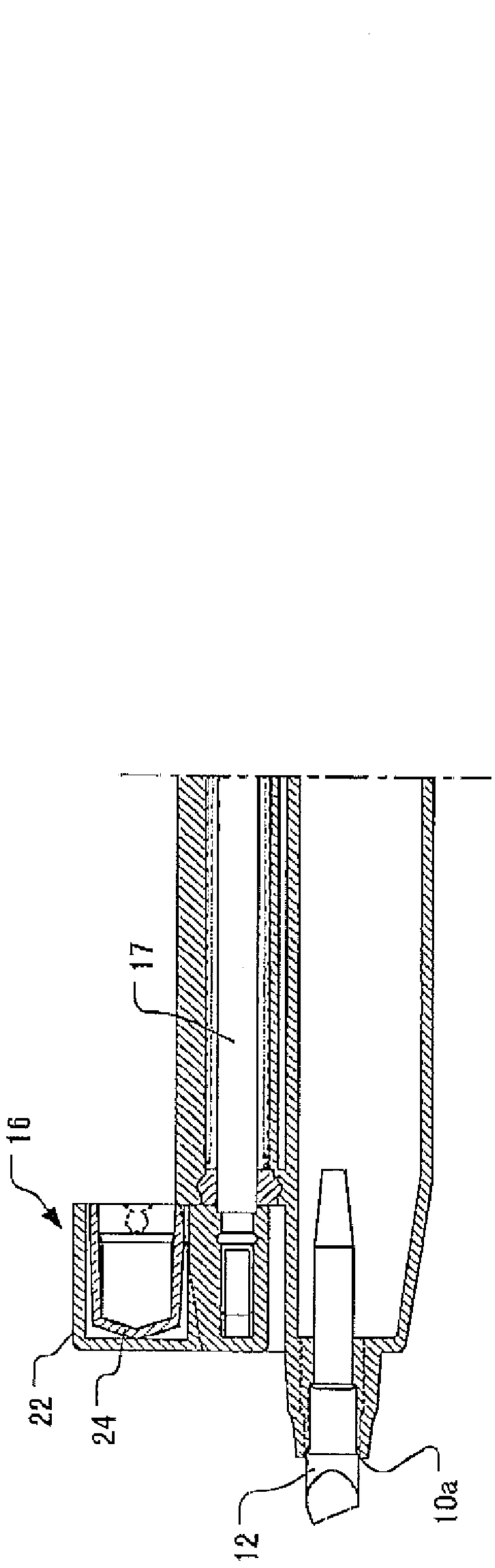


FIG. 1



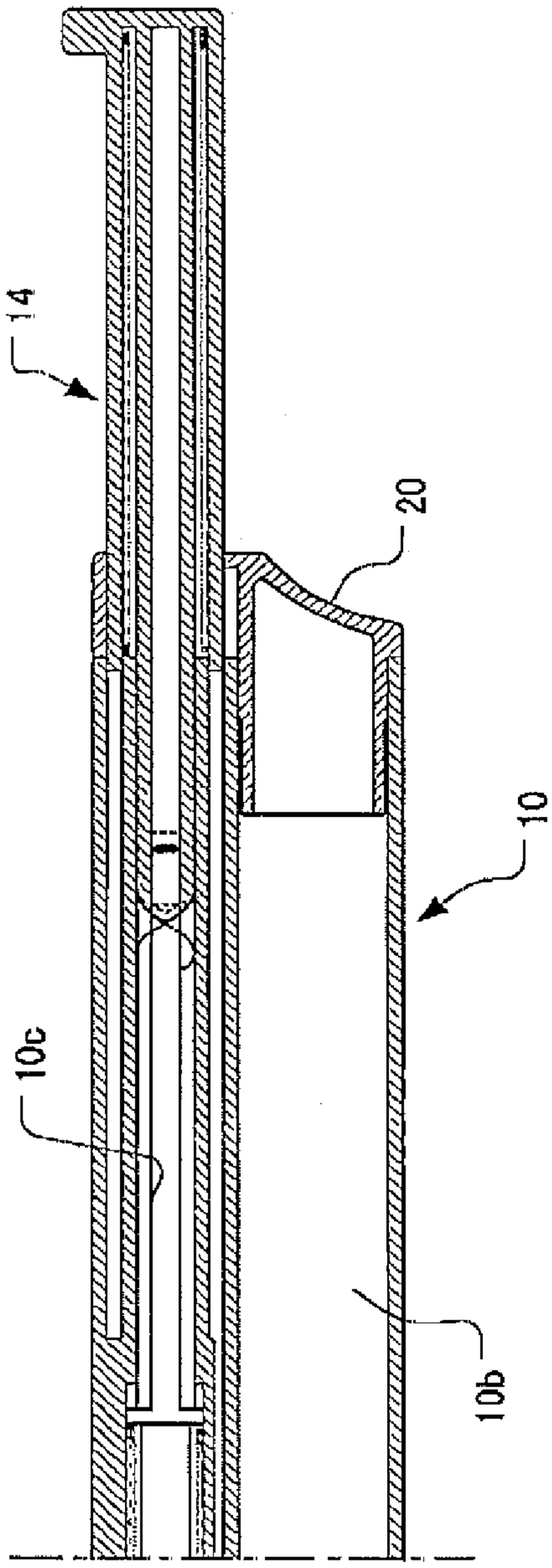


FIG.2

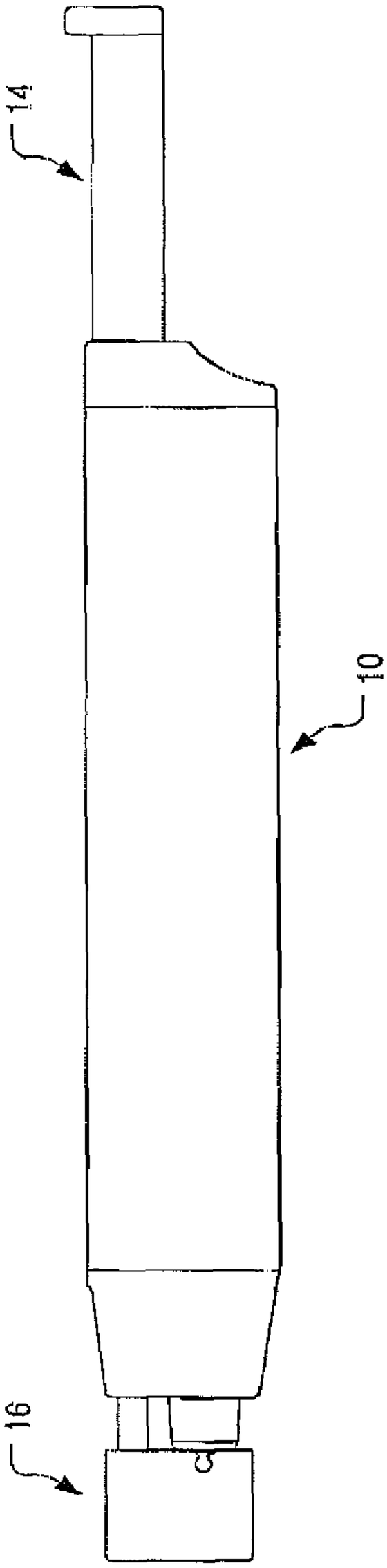


FIG. 3A

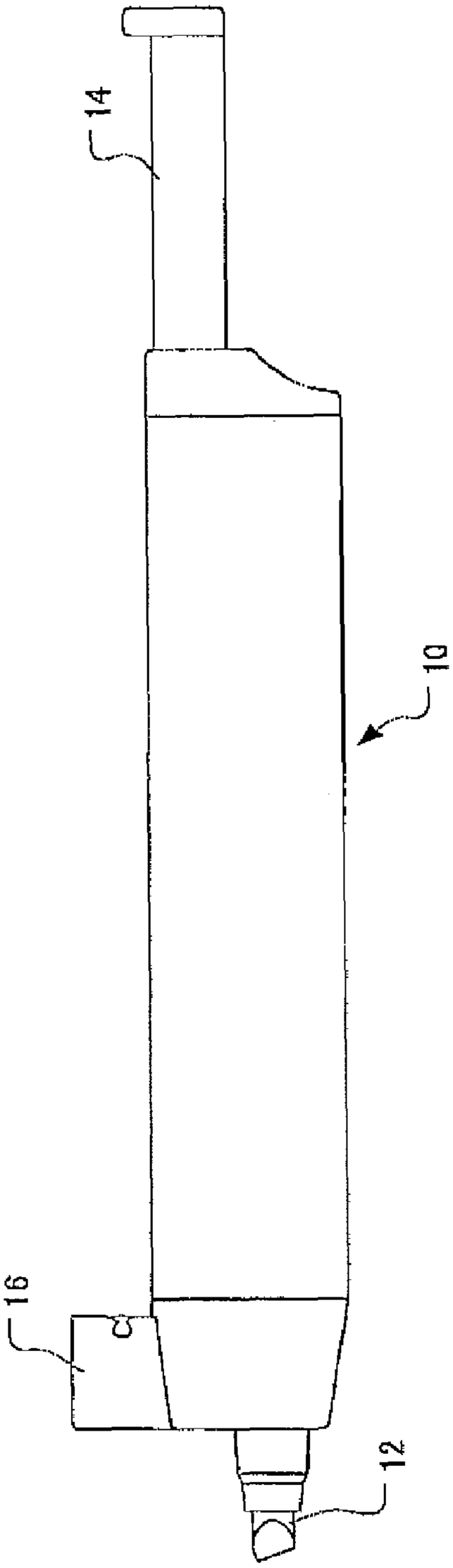
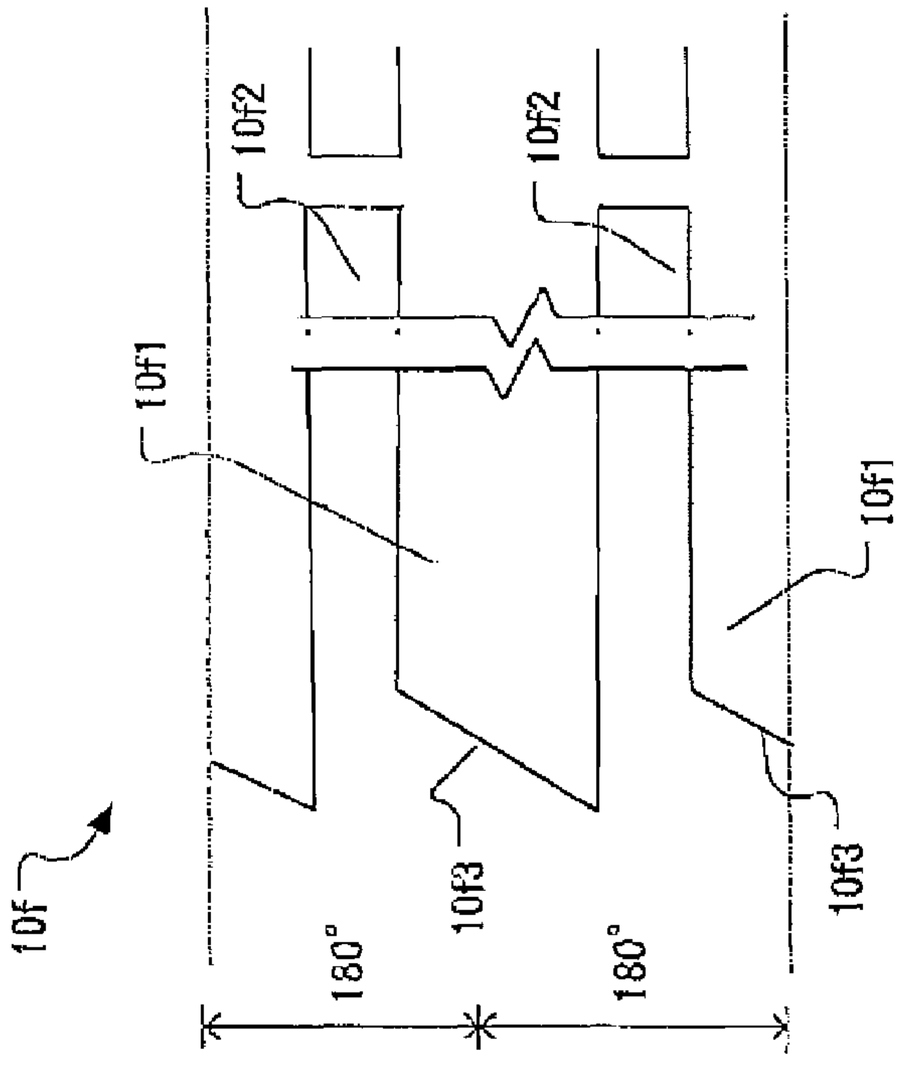


FIG. 3B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10f2
10f2
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10f3
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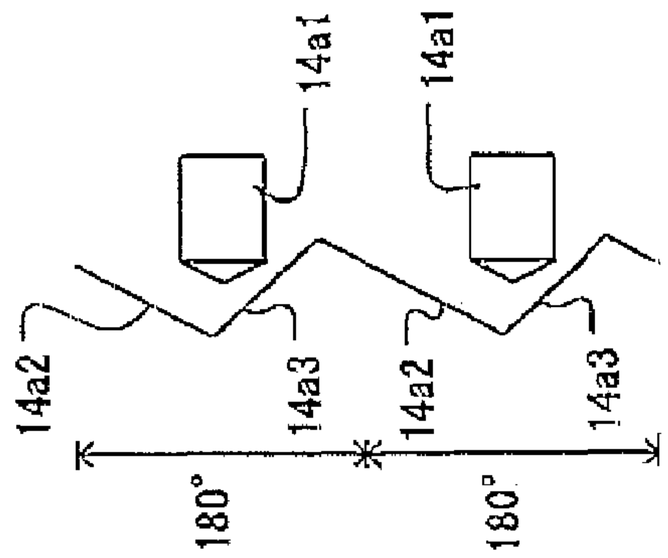
180°
180°

FIG. 4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14a2
14a3
14a2
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FIG. 5

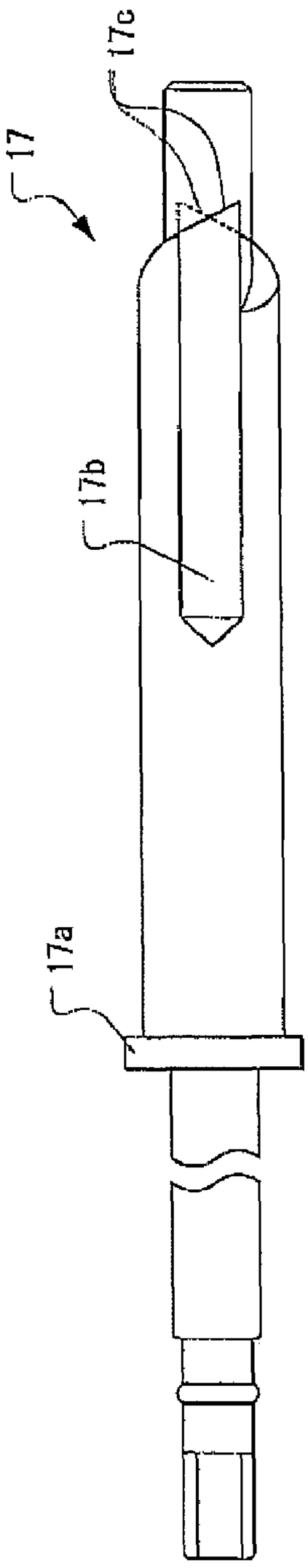

FIG.6A

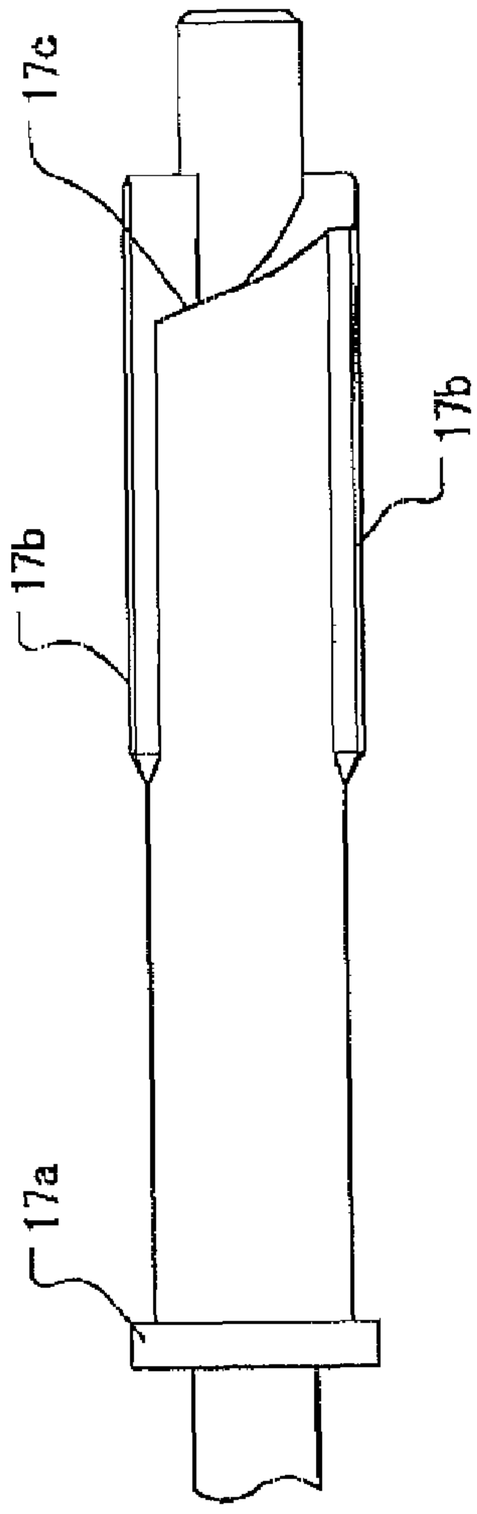

FIG.6B

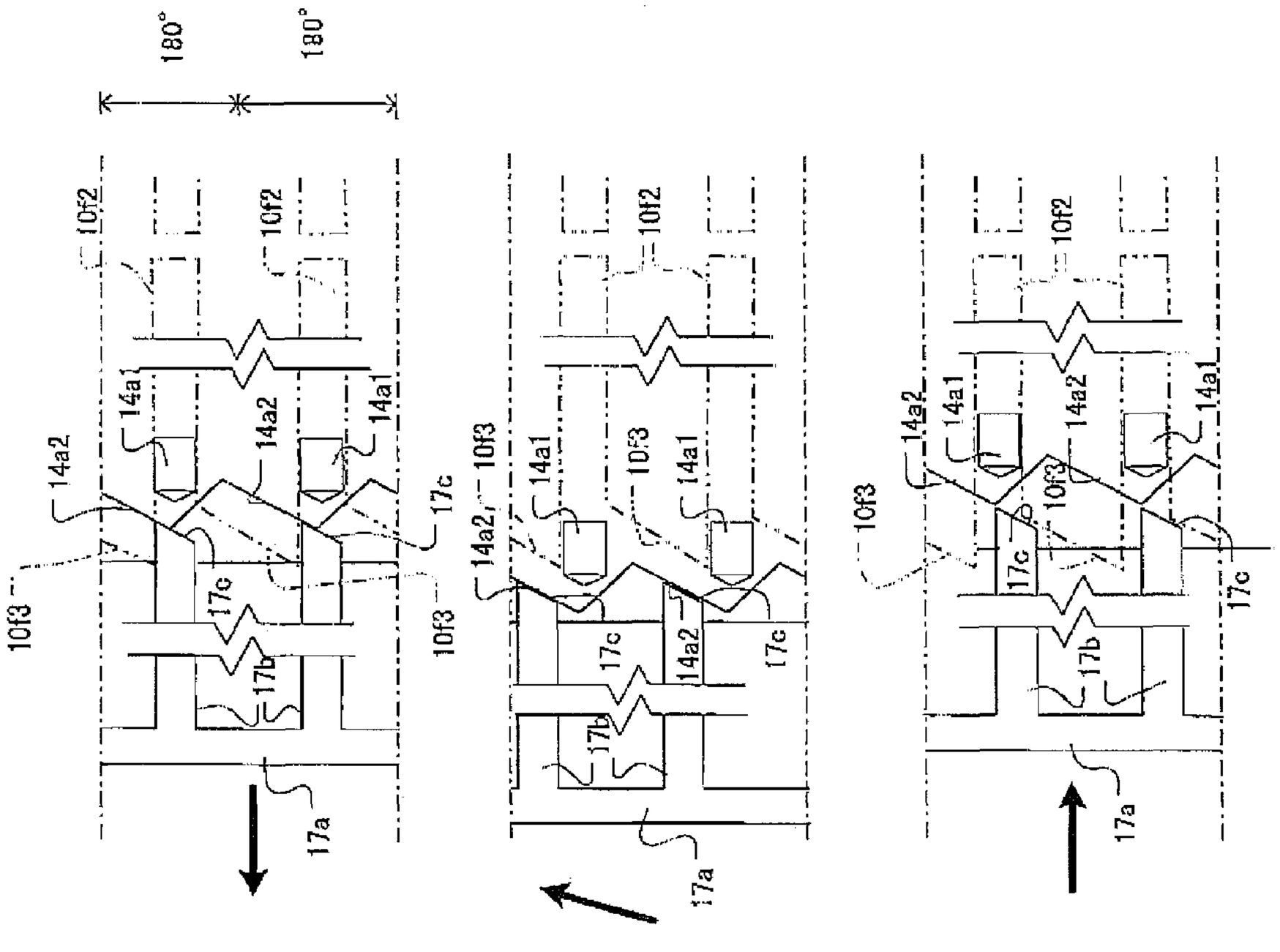

FIG. 7A

FIG. 7B

FIG. 7C

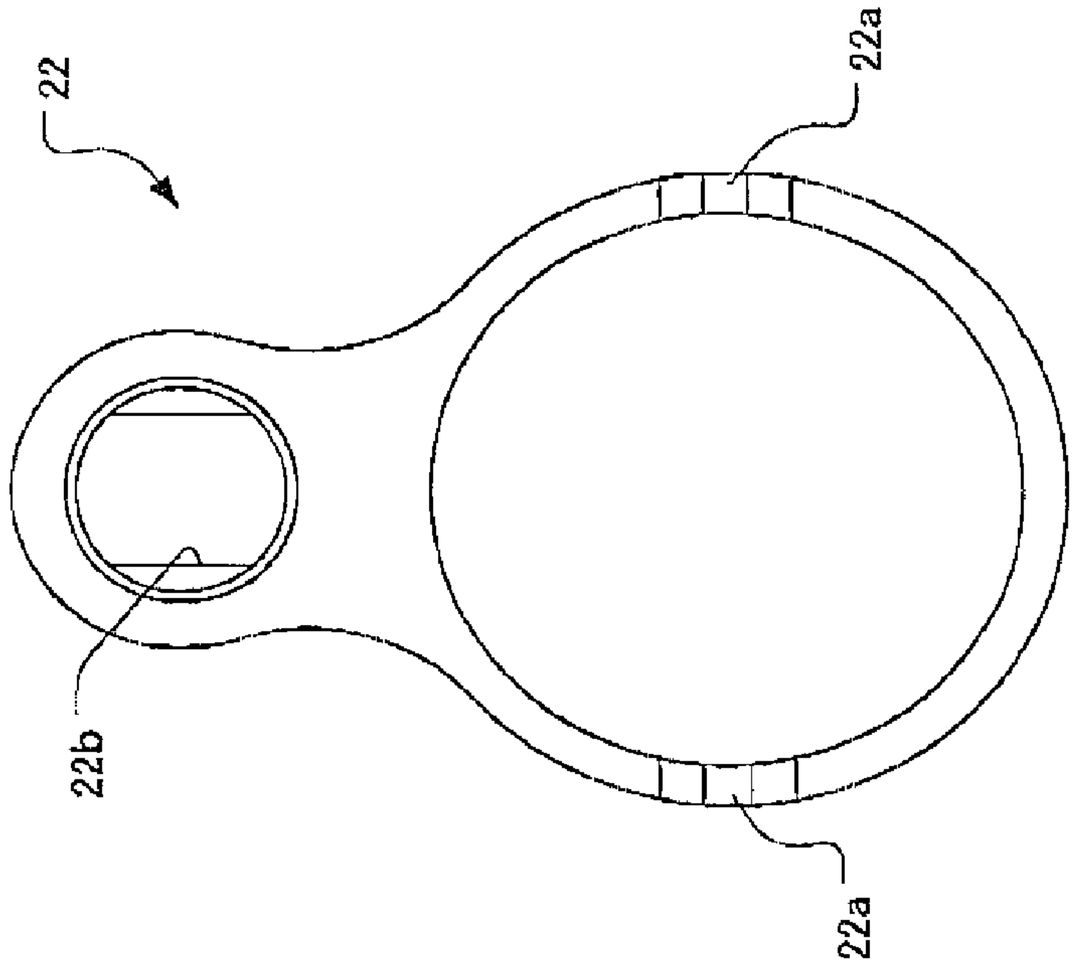

FIG.8B

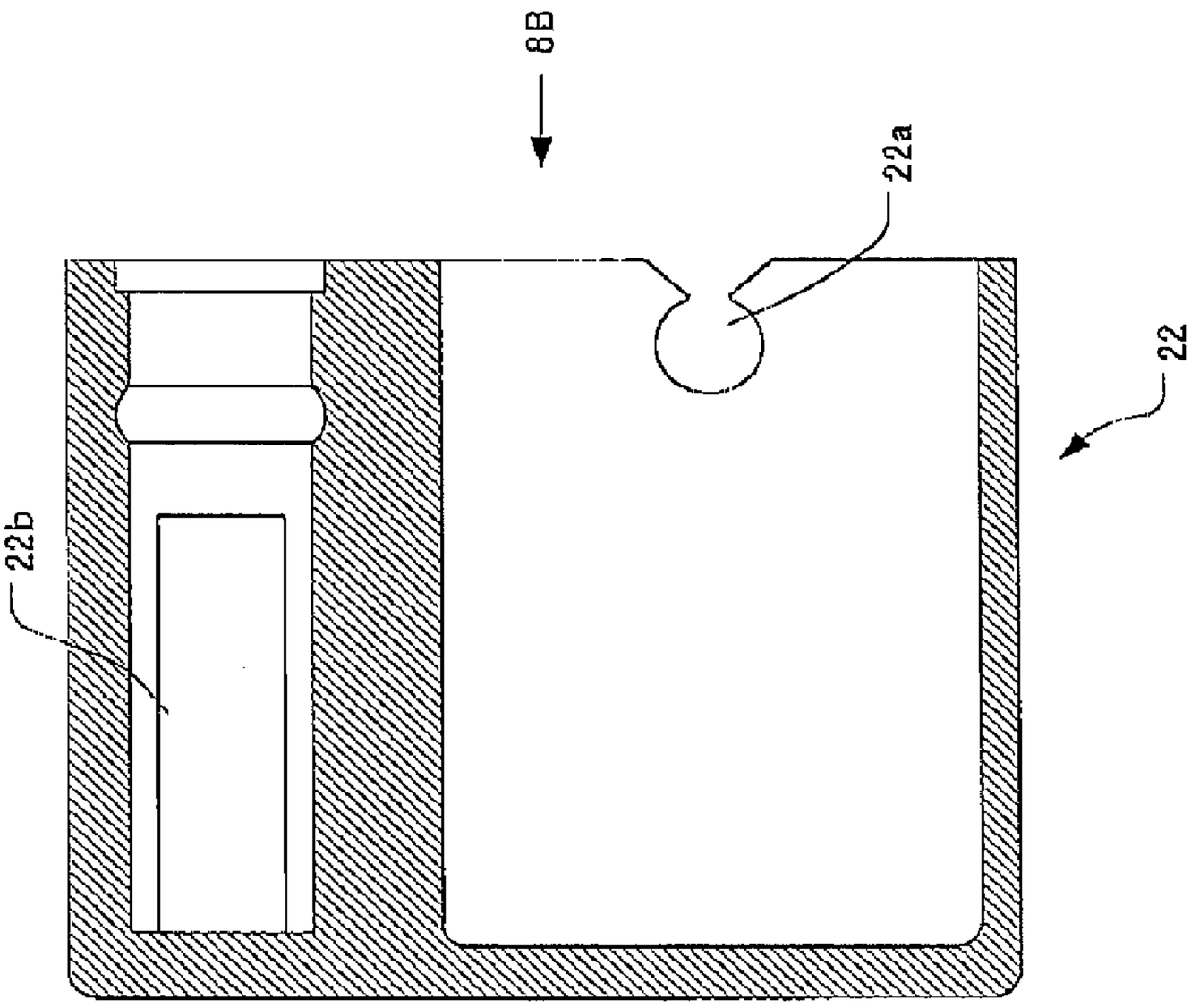

FIG.8A

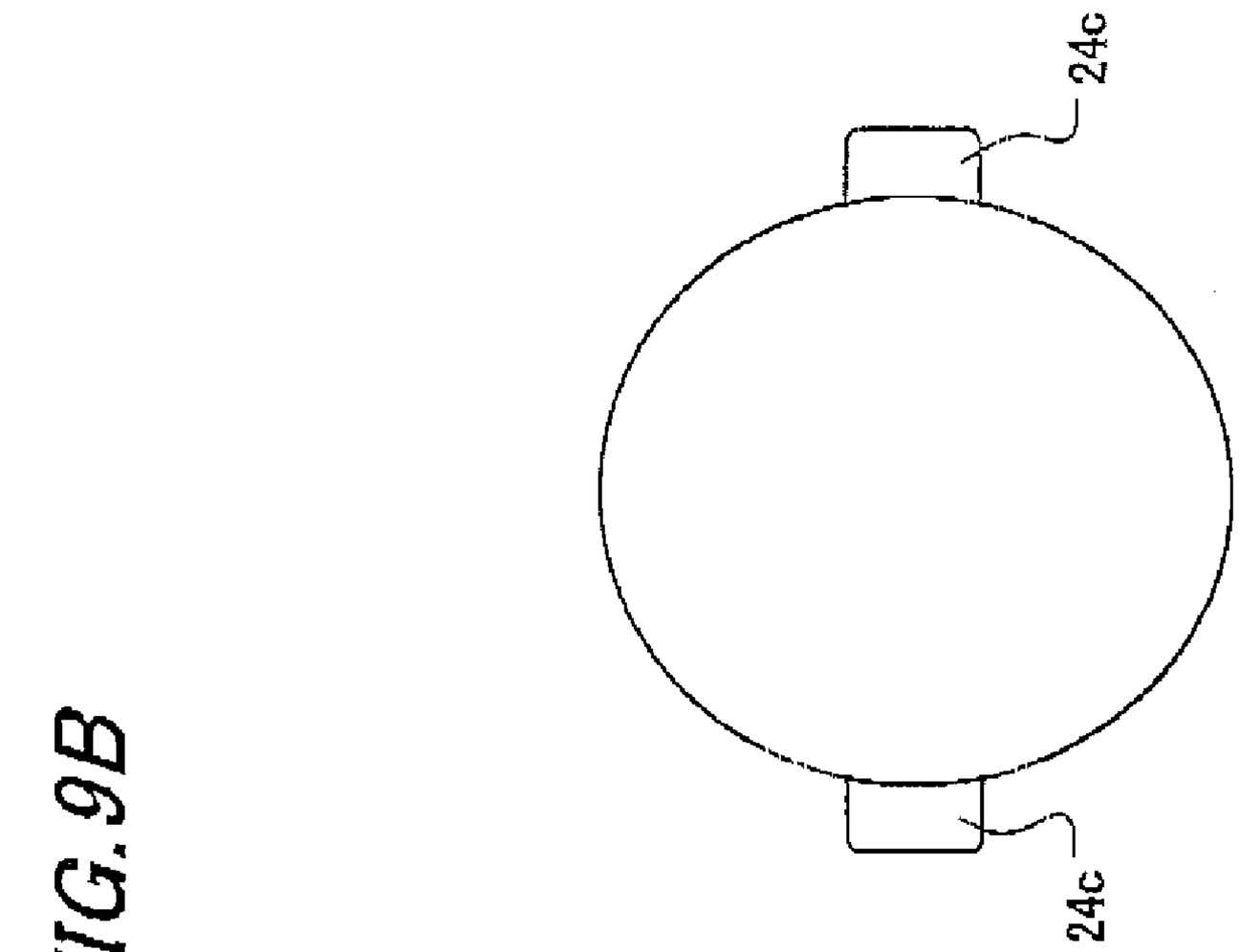

FIG.9B

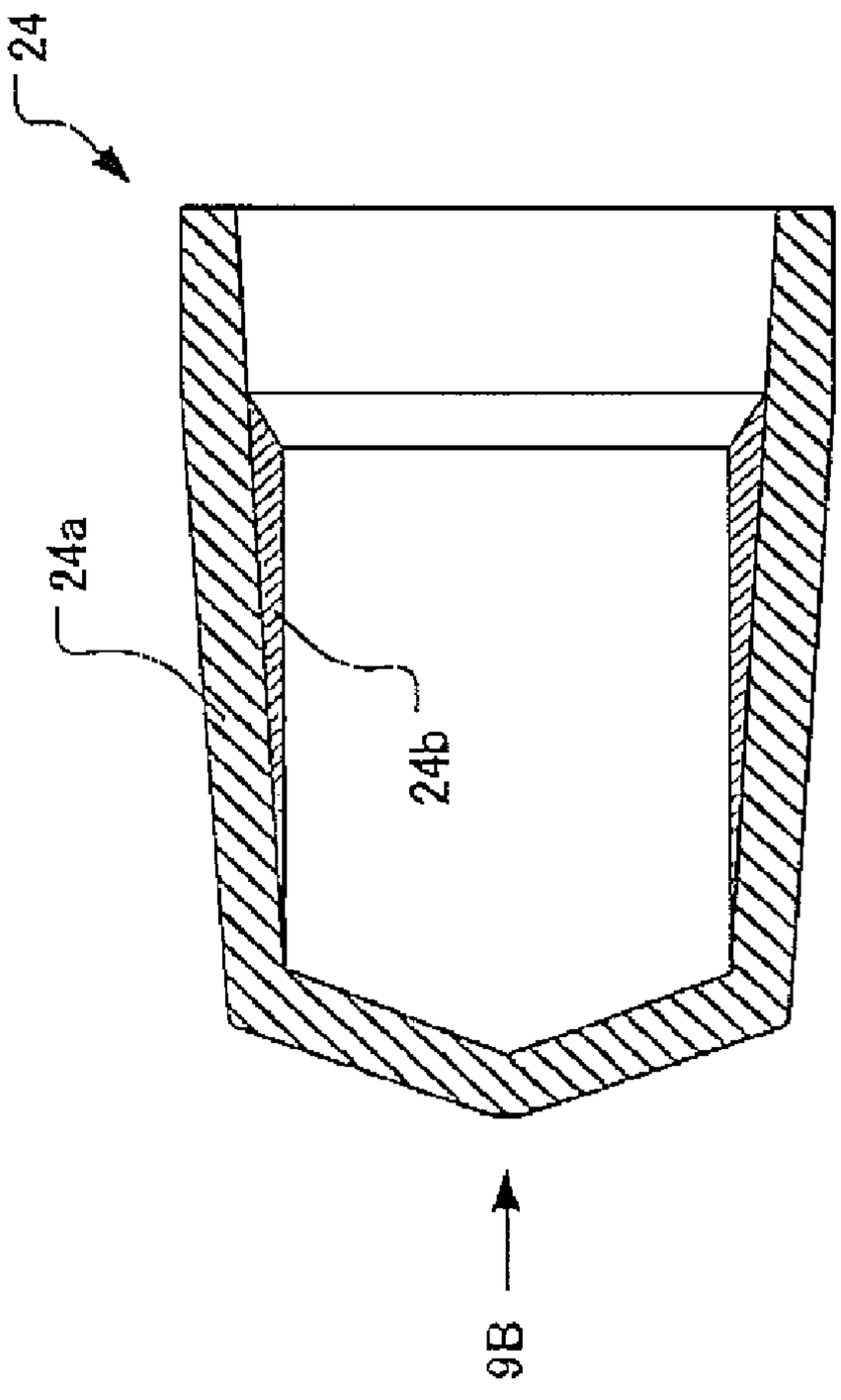

FIG.9A

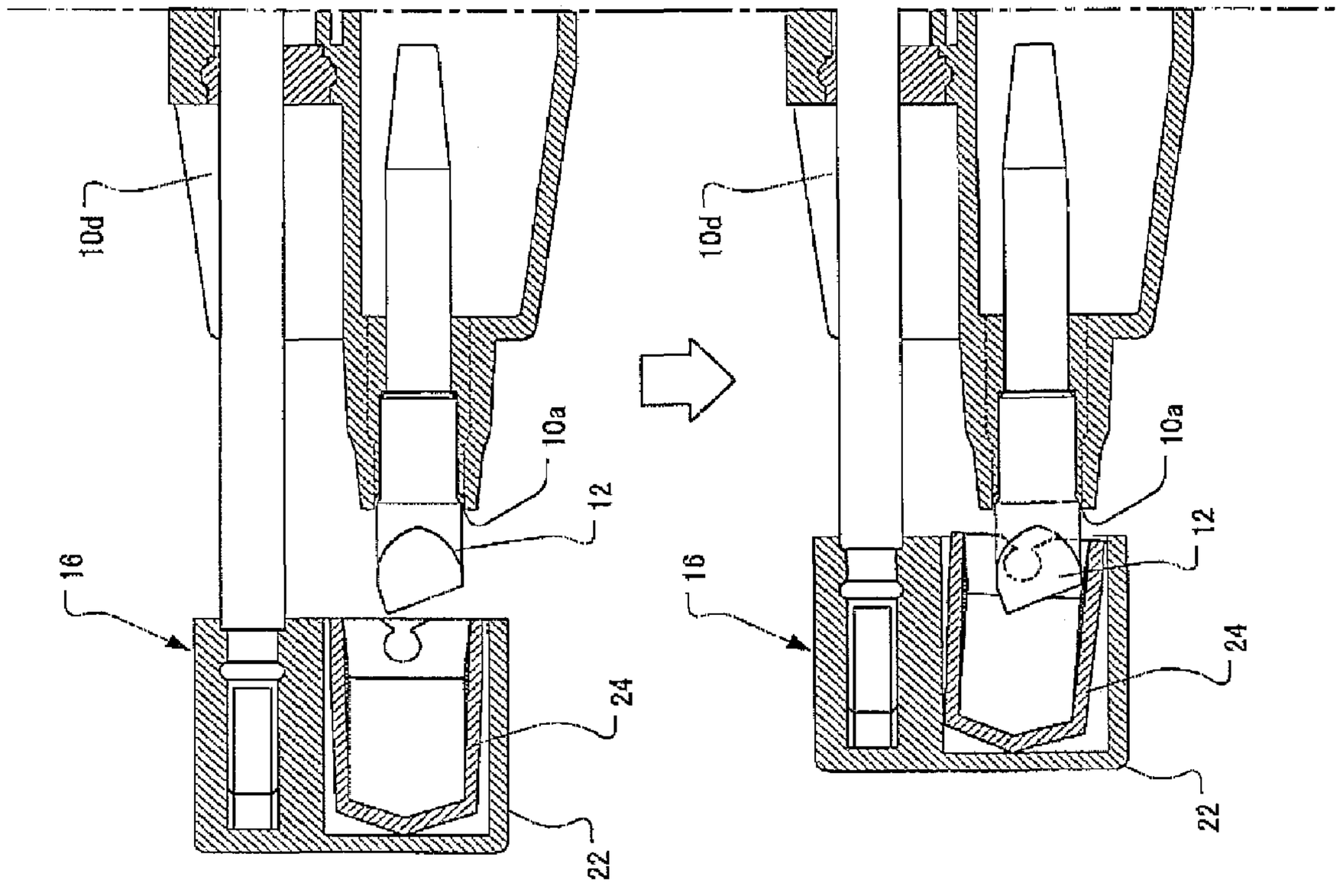

FIG. 10

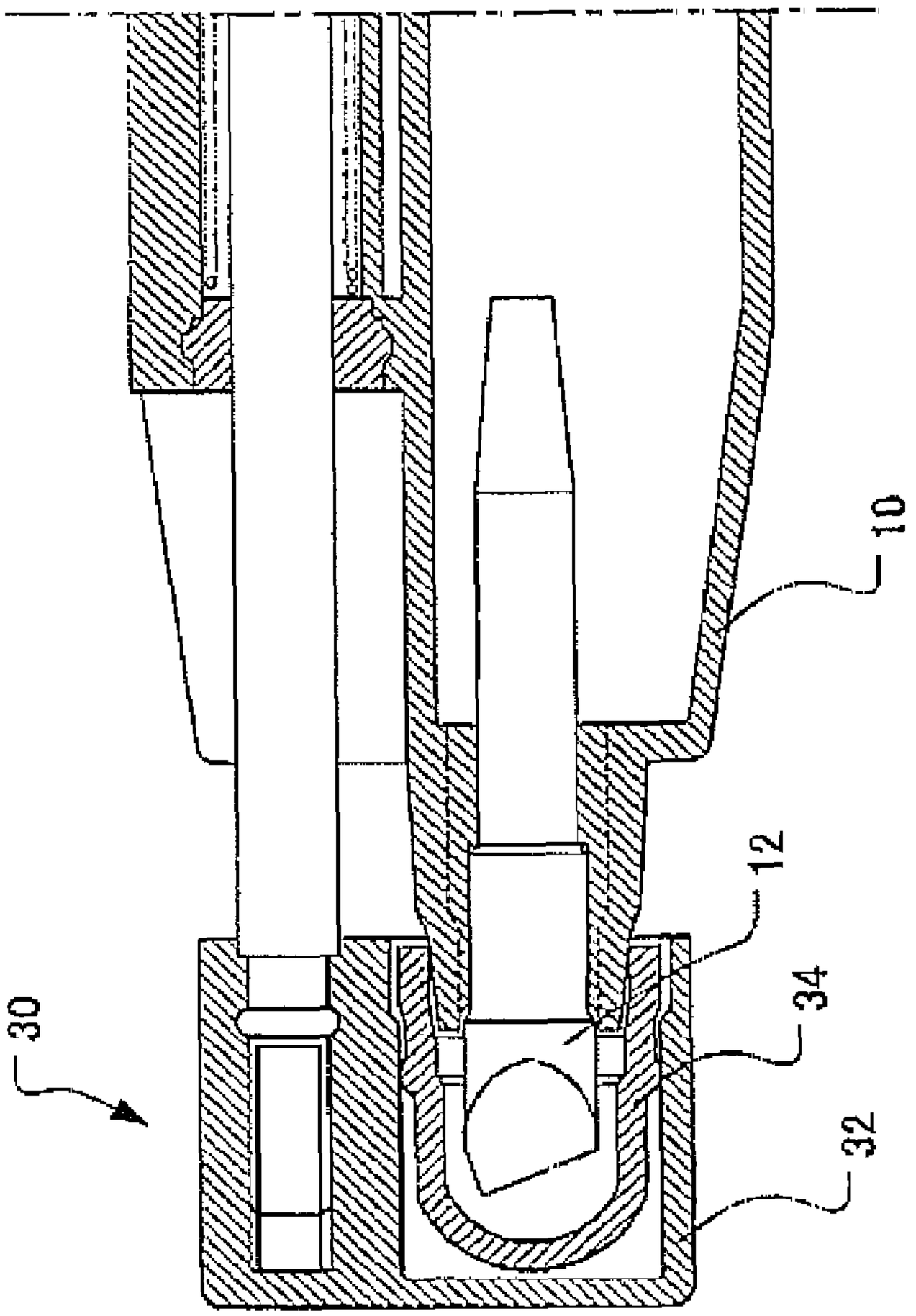

FIG. 11

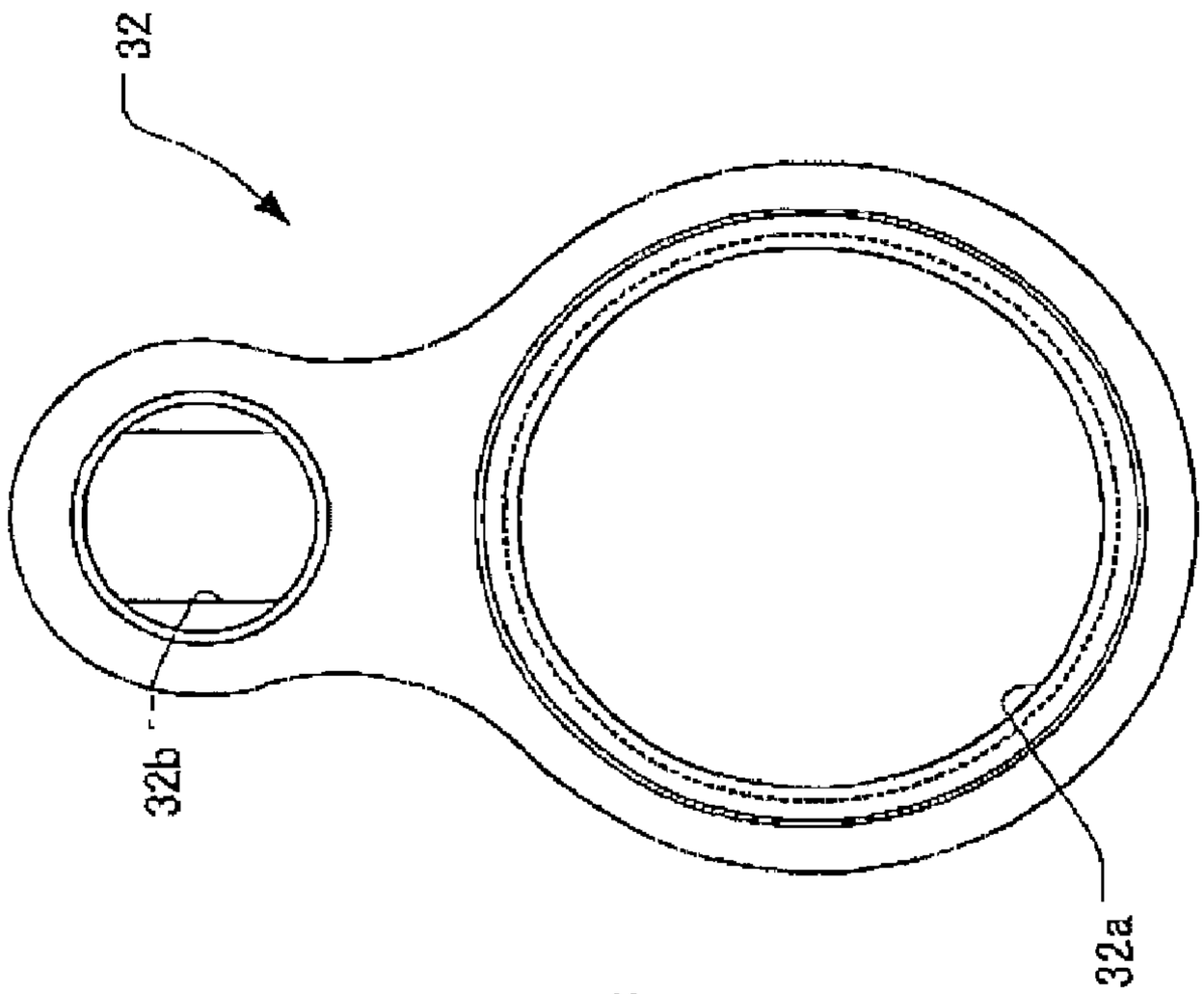

FIG. 12B

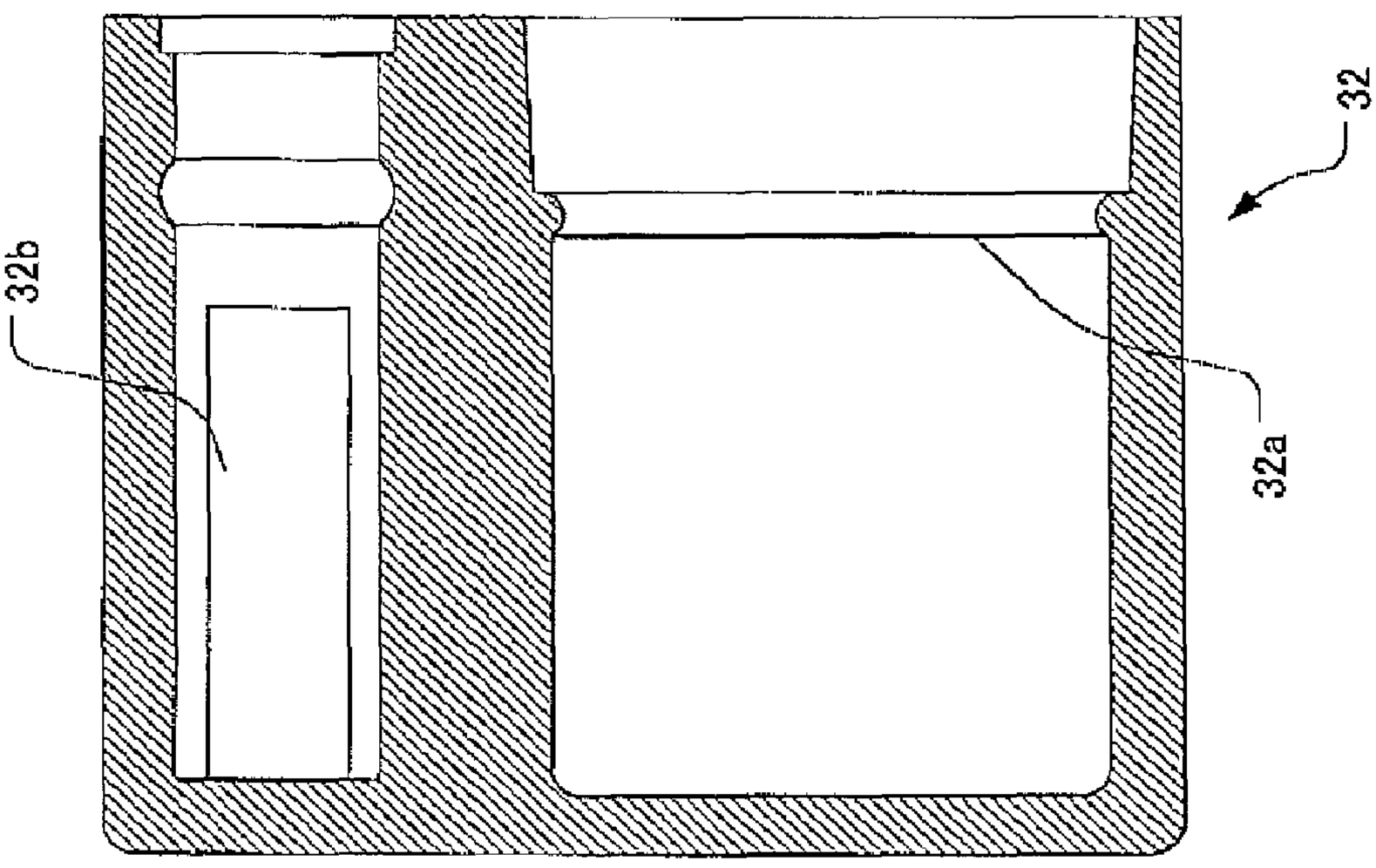

FIG. 12A

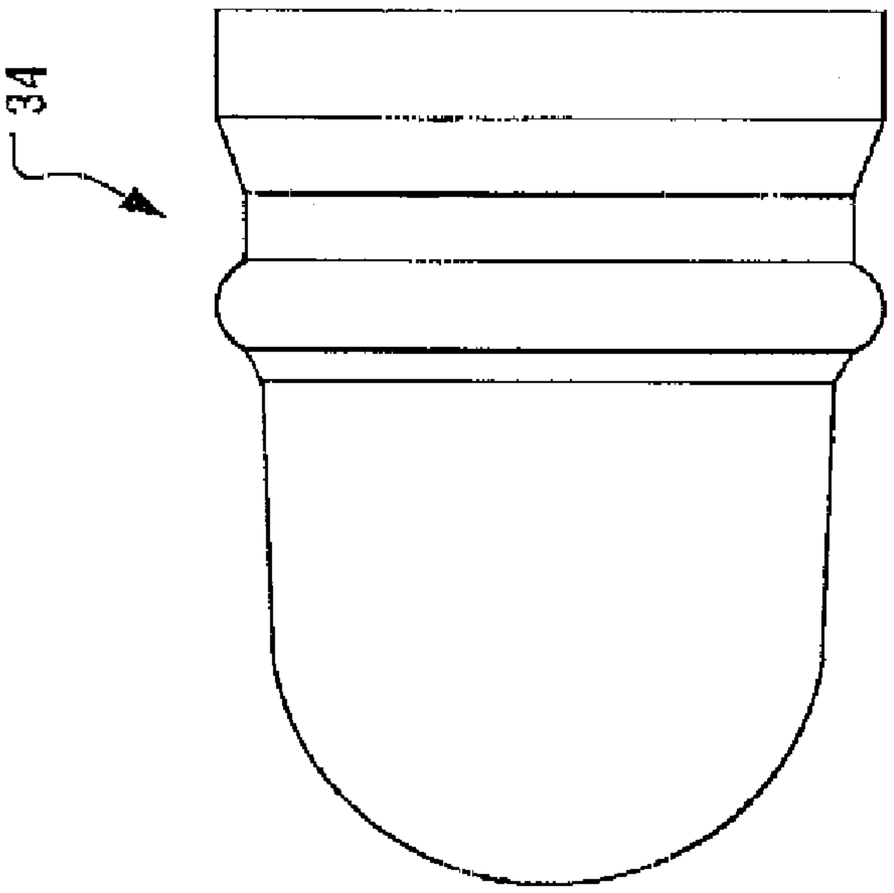

FIG. 13B

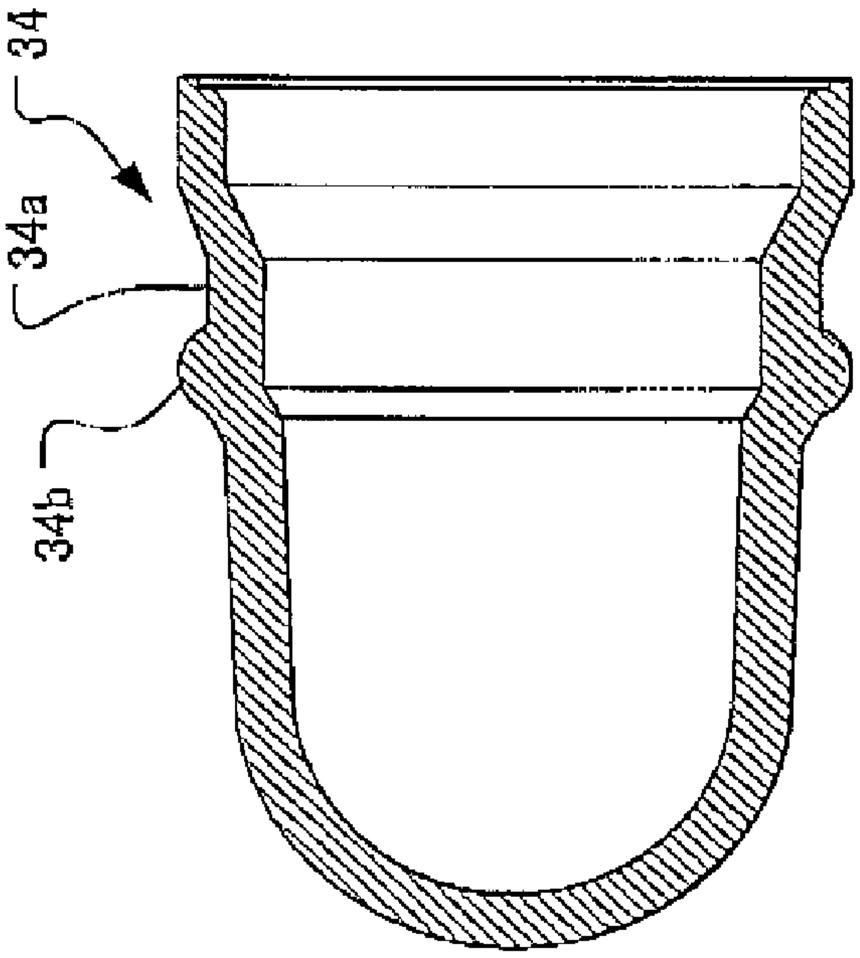

FIG. 13A

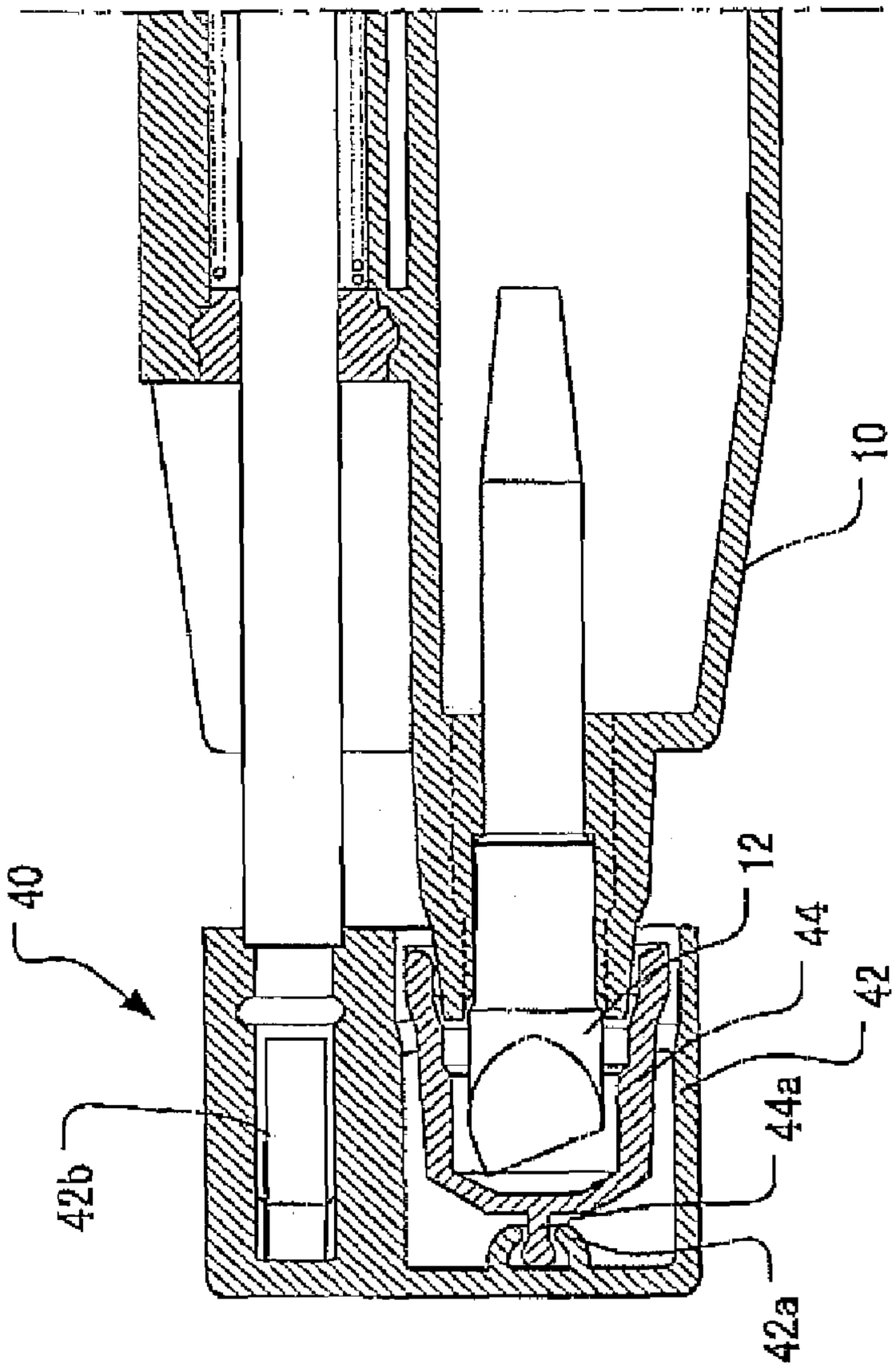

FIG. 14

AIRTIGHT CAP STRUCTURE

BACKGROUND OF THE INVENTION

1. Field of the Invention

The present invention relates to an airtight cap structure having a cap detachably covering a tip of an instrument such as stationeries and cosmetics for preventing the tip from drying.

2. Description of the Related Art

A conventional cap structure is described e.g. in Japanese Patent Laid-Open No. H9-30187. The cap structure described in Japanese Patent Laid-Open No. H9-30187 is a cap structure for a low-viscous ink writing instrument, wherein a cap comprises an outer cap and a cup-like sealing element fixed inside the outer cap and made of an elastic material, and a free peripheral edge of the sealing element comes into close contact with a tip periphery of an axial sleeve when the cap is mounted.

SUMMARY OF THE INVENTION

However, the cap structure described in the above publication has a limit of airtightness, even though the cup-like sealing element follows and comes into close contact with a tip to some degrees. In particular, a problem is that airtightness of the tip cannot be ensured after insertion under a condition that a relative angle or offset between the cap and the tip to be covered is not predicted.

The present invention is made in view of the above-mentioned problem, and an object of the present invention is to provide an airtight cap structure capable of coming into close contact with the tip and ensuring airtightness even under a condition that a unpredictable relative angle or offset between the cap and the tip to be covered happens.

For achieving the above-mentioned object, an airtight cap structure having a cap for detachably covering a tip to be used to prevent the tip from drying. The cap comprises an outer cap, and an inner cap installed in the outer cap. The inner cap is mounted to the outer cap so that the inner cap can incline relative to the central axial line of the cap, and the inner cap comes into close contact with the tip or its periphery when the cap covers the tip.

The inner cap can be mounted to the outer cap so as to be rotatable around an axis perpendicular to a central axial line of the cap. The cap structure can comprise a pair of shaft parts formed on any one of peripheries of the inner cap and the outer cap and extending in a radial direction, and shaft receiving holes formed on the other of the peripheries of the inner cap and the outer cap and receiving the shaft parts.

Alternatively, the inner cap can be mounted so as to be swingable around an annular part formed on the inner periphery of the outer cap. The cap structure can comprise an annular recess formed on any one of the peripheries of the inner cap and the outer cap, and a projection formed on the other of the peripheries of the inner cap and the outer cap and loosely fitted with the recess.

Alternatively, the inner cap is mounted to the outer cap so as to be pivotable around a central axial line of the cap. The cap structure can comprise a receiving part formed on any one of peak surfaces of the inner cap and the outer cap, and a pivot part formed on the other of the peak surfaces of the inner cap and the outer cap and pivoted to the receiving part.

An instrument comprises a cap having an airtight cap structure as described above, an axial sleeve holding a tip, a knocking member installed to the axial sleeve for attaching and detaching the cap, and a rotation converting mechanism

connecting the cap with the knocking member. The rotation converting mechanism moves the cap forward, rotates it around an axis parallel to the axial direction, and then moves it backward, in response to one knock in an axial direction of the knocking member. Every knock of the knocking member, the cap can be switched between a condition that the cap covers the tip, and a condition that the cap exposes the tip.

According to the present invention, even if the cap approaches to the tip to cover it having a relative angle or offset, the inner cap is inclined, follows the tip, and guides the tip to a normal direction and position. Therefore, the cap can surely come into close contact with the tip or its periphery, so as to ensure airtightness.

The present disclosure relates to subject manner contained in Japanese Patent Application No. 2005-325270, filed on Nov. 9, 2005, which is expressly incorporated herein by reference in its entirety.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. **1** is an overall sectional view showing an example, in which an airtight cap structure according to a first embodiment of the present invention is applied to a writing instrument;

FIG. **2** is an overall sectional view showing an example, in which an airtight cap structure according to the first embodiment of the present invention is applied to a writing instrument;

FIG. **3** is an overall view of the writing instrument of FIG. **1**, FIG. **3**A shows a condition that a cap covers the tip, and FIG. **3**B shows a condition that the cap exposes the tip;

FIG. **4** is a developed view of a cam body;

FIG. **5** is a developed view of a tip of a knocking cam;

FIG. **6**A is a plane view of a rotary cam rod, and FIG. **6**B is a partial side view thereof;

FIGS. **7**A to **7**C show operations of a rotation converting mechanism;

FIG. **8**A is a sectional view of an outer cap, and FIG. **8**B is a view seen from a direction **8**B of FIG. **8**A;

FIG. **9**A is a sectional view of an inner cap, and FIG. **9**B is a view seen from a direction **9**B of FIG. **9**A;

FIG. **10** is an enlarged view when the cap is mounted;

FIG. **11** is a partial enlarged sectional view showing an example, in which an airtight cap structure according to a second embodiment of the present invention is applied to a writing instrument;

FIG. **12**A is a sectional view of an outer cap, and FIG. **12**B is a view seen from a direction **12**B of FIG. **12**A;

FIG. **13**A is a sectional view of an inner cap, and FIG. **13**B is a side view thereof; and

FIG. **14** is a partial enlarged sectional view showing an example, in which an airtight cap structure according to a third embodiment of the present invention is applied to a writing instrument.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

Now, embodiments of the present invention will be explained with reference to drawings.

FIGS. **1** to **3** show an example, in which an airtight cap structure according to a first embodiment of the present invention is applied to a writing instrument. In FIGS. **1** to **3**, the writing instrument has an axial sleeve **10** holding a tip **12** to be used, a cap **16** comprising a cap structure according to

the present invention, and a knocking member **14** for operating of attaching and detaching the cap **16**.

The tip **12** to be used, in this example, is a chip for a marker to transfer ink accommodated in a main axial hole **10***b* in the axial sleeve **10**, and is fixed at a tip opening **10***a* of the main axial hole **10***b*. However, the tip **12** is not limited to it, but any tip can be applied which is suitable for arbitrary writing or applying media suitable for instruments for stationeries and cosmetics such as a ball-point pen, a fountain pen, an eye liner, a lip liner, an eye shadow chip, or like. For example, when the instrument is a ball-point pen, the tip **12** can comprise a ball, and when the instrument is a felt pen, the tip **12** comprises a core made of felt.

The tip **12**, in this example, is integrally fixed to the axial sleeve **10**, but is not limited to that. For example, when the tip **12** is an end of a refill, the tip **12** can be hold movably relative to the axial sleeve **10**. Similarly, in the illustrated example, the axial sleeve **10** is constituted as a unitary part, but may be constituted of a plurality of parts.

The axial sleeve **10** is provided inside with a sliding axial hole **10***c* extending in an axial direction in parallel to the main axial hole **10***b*, and the knocking member **14** is arranged in the sliding axial hole **10***c* so as to movable in the axial direction of the hole **10***c*.

The front end of the knocking member **14** includes a knocking cam **14***a* to be inserted in the sliding axial hole **10***c*, and the rear end of the knocking member **14** includes a knocking operation part **14** *b* exposed from the axial sleeve **10**. The knocking cam **14***a* and the knocking operation part **14***b* can be constituted as separate parts. The knocking operation part **14***b* can be knocked toward the axial sleeve **10**, and the knocking cam **14***a* moves in the axial direction in the sliding axial hole **10***c* by the knocking operation. The knocking operation part **14***b* is always urged backward by a knocking spring **15**, but is prevented from backward detachment from the axial sleeve **10**.

A recess **10***d*, in which the cap **16** can be inserted, is formed at the front of the axial sleeve **10** adjacent to the tip opening **10***a* from which the tip **12** projects, and at least a part of the cap **16** can be accommodated in the recess **10***d*.

A rotary cam rod **17** is integrally connected with the cap **16**. The rotary cam rod **17** extends backward from the cap **16**, and can move in an axial direction in the sliding axial hole **10***c*. A return spring **18** is wound around the outer periphery of the rotary cam rod **17**, and is interposed between a stopper **19** fixed near a tip inlet of the sliding axial hole **10***c* and a collar part **17***a* whose diameter is enlarged at the intermediate portion of the rotary cam rod **17**, so as to always urge the rotary cam rod **17** and the cap **16** backward.

A tail plug **20** closing the rear end of the main axial hole **10***b* is mounted to the rear end of the axial sleeve **20**.

The cap **16** is connected with the knocking member **14** via a rotation converting mechanism or a rotary cam mechanism, which comprises the rotary cam rod **17**, a cam body **10***f* formed in the sliding axial hole **10***c*, the knocking cam **14***a* and the return spring **18** as an elastic body. That is to say, as shown in the developed view of FIG. **4**, the cam body **10***f* includes ridges **10***f***1**, **10***f***1** formed every 180 degrees, and vertical grooves **10***f***2**, **10***f***2** as valleys formed between two adjacent ridges **10***f***1**, **10***f***1**. Cam surfaces **10***f***3**, **10***f***3** faced to the front and inclined in the axial direction are formed at the front end of the ridges **10***f***1**, **10***f***1**.

On the other hand, as shown in the developed view of FIG. **5**, protrusions **14***a***1**, **14***a***1** are formed on the outer periphery of the knocking cam **14***a* every 180 degrees, and two kinds of cam surfaces **14***a***2**, **14***a***3** inclined in the axial direction are formed on the front end surface of the knocking cam **14***a* every 180 degrees. The cam surfaces **14***a***2** are gently inclined while the cam surfaces **14***a***3** are steeply inclined. Both of the cam surfaces are faced to the front, and inclined in opposite directions. The protrusions **14***a***1**, **14***a***1** are slidably fitted in the vertical grooves **10***f***2**, **10***f***2** of the cam body **10***f*, so that the knocking cam **14***a* cannot rotate relatively to the sliding axial hole **10***c*, but can move in the axial direction.

As shown in FIG. **6**, two vertical ribs **17***b*, **17***b* are formed on the outer periphery backward of the collar part **17***a* of the rotary cam rod **17** at 180 degrees angularly spaced. The vertical ribs **17***b*, **17***b* are slidably fitted in the vertical grooves **10***f***2**, **10***f***2** of the cam body **10***f*. Cam surfaces **17***c*, **17***c* are formed on the rear end surfaces of the vertical ribs **17***b*, **17***b*. The rotary cam rod **17** can move in the axial direction along the sliding axial hole **10***c*, and can rotate relatively to the sliding axial hole **10***c* when the vertical ribs **17***b*, **17***b* come out from the vertical grooves **10***f***2**, **10***f***2** of the cam body **10***f* and located at the front.

As shown in FIG. **7**, when the knocking operation part **14***b* is knocked, the knocking cam **14***a* moves forward in the sliding axial hole **10***c*, and the tip of the knocking cam comes into contact with the rear end of the rotary cam end **17**, so as to move the rotary cam rod **17** forward. When the vertical ribs **17***b*, **17***b* of the rotary cam rod **17** come out from the vertical grooves **10***f***2**, **10***f***2** of the cam body **10**, the cam surfaces **17***c*, **17***c* of the rotary cam rod **17** slide along the cam surfaces **14***a***2**, **14***a***2** of the knocking cam **14***a* by an urging force of the return spring **18** together with this backward movement, so that the rotary cam rod **17** rotates. Furthermore, when a knocking force of the knocking operation part **14***b* is released, the cam surfaces **17***c*, **17***c* slide along the cam grooves **10***f***2**, **10***f***2** of the cam body **10***f*, and the rotary can rod **17** rotates by 180 degrees. Thereafter, the vertical ribs **17***b*, **17***b* are fitted in the vertical grooves **10***f***2**, **10***f***2** of the cam body **10** different from previous grooves by 180 degrees, and move backward.

As the rotary cam rod **17** moves forward, rotates by 180 degrees, and moves backward as described above, the cap **16** also moves forward, and it moves forward than the tip **12**, rotates around the axial line of the rotary cam rod **17** as a rotational center by 180 degrees, moves backward, and is accommodated in the recess **10***d*. Thereby, the tip **12***a* of the refill **12** is exposed, so as to enable writing (see FIGS. **2** and **3**B).

After completion of writing, when the knocking operation pact **14***b* is knocked again, as is similar to a previous case, the rotary cam rod **17** moves forward, rotates by 180 degrees and moves backward in cooperation with the knocking cam **14***a*, the cam body **10***f* and the rotary cam rod **17**. Therefore, the cap **16** moves forward from the recess **10***d*, rotates around the axial line of the rotary cam rod **17** as a rotational center by 180 degrees, and moves backward, so as to cover the tip **12** (see FIGS. **1** and **3**A).

As described above, when the cap **16** is attached or detached by a remote operation of the knocking operation part **14***b*, a mounting failure of the cap **16** sometimes occurs due to slight inclination or positional displacement between the cap **16** and the tip **12**, which might lead to deterioration of airtightness of the tip **12**.

Therefore, the cap **16** according to the present invention comprises an outer cap **22**, and an inner cap **24** arranged inside a main body of the outer cap **22**, and the inner cap **24** can be inclined relative to the central axial line of the cap against the outer cap **22**. More particularly, as shown in FIG. **8**, the outer cap **22** has shaft receiving holes **22***a*, **22***a* adjacent to an opening of the main body. Also, the cap **22** has

a receiving hole **22***b* apart from the main body of the cap **22**. The recessing hole **22***b* receives the tip of the rotary cam rod **17** in such a manner that it cannot rotate and cannot move in the axial direction relative to the rotary cam rod **17**.

As shown in FIG. **9**, the inner cap **24** is molded by two color molding, comprised of a hard part **24***a* made of hard resin, and a soft part **24***b* positioned inside the hard part **24***a* and made of elastic soft resin. The soft part **24***b* can be formed of thermoplastic elastomer and the like. Furthermore, shaft parts **24***c*, **24***c* which can be inserted in the shaft receiving holes **22***a*, **22***a* are projected on the outer periphery of the hard part **24***a* of the inner cap **24**.

The shaft parts **24***c*, **24***c* of the inner cap **24** are fitted into the shaft receiving holes **22***a*, **22***a* of the outer cap **22**, so that the inner cap **24** can rotate around the axis perpendicular to the central axial line of the cap **16** relative to the outer cap **22** with the shaft part **24***c* being a center.

Because the inner cap **24** can rotate relative to the outer cap **22**, when the cap **16** is being mounted, even if the respective central axial lines of the cap **16** and the tip **12** are not aligned with each other, or the central axial lines of the cap **16** and tip **12** are inclined to each other, the inner cap **24** is adapted to the tip **12** while inclining to the central axial line of the cap, and corrects the position of the cap **16**, as shown in FIG. **1**. Therefore, the tip **12** is finally accommodated in the cap **16** at a right position, and the soft part **24***b* of the inner cap **24** surely comes into contact with the tip of the axial sleeve **10** around the tip **12**, so that airtightness can be kept.

Instead of that the shaft receiving holes **22***a*, **22***a* are provided on the outer cap **22** and the shaft parts **24***a*, **24***a* are provided the inner cap **24**, the shaft parts may be provided on the outer cap and the shaft receiving holes may be provided on the inner cap. Additionally, the outer cap and the inner cap may comprise a plurality of components, respectively. The inner cap may be entirely made of the soft material only.

Now, FIG. **11** is a sectional view showing an instrument, to which a cap structure in a second embodiment of the present invention is applied. In FIG. **11**, identical members as those in the first embodiment are assigned respectively to the same reference numbers, and detailed explanation thereof will be omitted.

A cap **30** according to a cap structure in this embodiment comprises an outer cap **32**, and an inner cap **34** arranged inside the outer cap **32**, and the inner cap **34** can swing relative to the outer cap **32**. More particularly, as shown in FIG. **12**, the outer cap **32** has an annular projection **32***a* on its inner periphery. Furthermore, the outer cap **32** has a receiving hole **32***b* apart from the main body. The receiving hole **32***b* receives the tip of the rotary cam rod **17** in such a manner that it cannot rotate and cannot move in the axial direction relative to the rotary cam rod **17**.

As shown in FIG. **13**, an annular recess **34***a* that can be fitted with the annular projection **32***a*, and an annular projection **34***b* adjacent to the annular recess **34***a* are formed on the outer periphery of the inner cap **34**.

The annular projection **32***a* of the outer cap **32** is loosely fitted in the annular recess **34***a* of the inner cap **34** having a play, and the inner cap **34** can swing relative to the outer cap **32** with an annular contact line to the outer cap **32** of the annular projection **34***b* being a center. To smoothen this swinging movement, the surface of the annular projection **34***b* is curved as illustrated.

In this manner, swinging the inner cap **34** allows the inner cap **34** to incline relative to the central axial line of the cap so as to obtain operations and effects similar to those of the first embodiment.

The annular recess and the annular projection may be formed on any of the outer cap and the outer cap, respectively. Also, the outer cap and the inner cap may comprise a plurality of components, respectively. In this example, at least a part of inside part of the inner cap may be made of or whole soft material.

Now, FIG. **14** is a sectional view showing a writing instrument, to which a cap structure in a third embodiment of the present invention is applied. In FIG. **14**, identical members as those in the second embodiment are assigned respectively to the same reference numbers, and detailed explanation thereof will be omitted.

A cap **40** according to a cap structure in this embodiment comprises an outer cap **42**, and an inner cap **44** arranged inside the outer cap **42**, and the inner cap **44** can swing relative to the outer cap **42**. More particularly, the outer cap **42** has a receiving part **42***a* on a peak rear inside of the main body of the outer cap. Furthermore, the outer cap **42** has a receiving hole **42***b* apart from the main body. The receiving hole **42***b* receives the tip of the rotary cam rod **17** in such a manner it cannot rotate and cannot move in the axial direction relative to the rotary cam rod **17**.

A pivot part **44***a* that can be fitted with the receiving part **42***a* is formed on the peak top outside of the inner cap **44**.

The tip of the pivot part **44***a* of the inner cap **44** is inserted into the receiving part **42***a* from the inlet thereof, so that the inner cap **44** can be inclined, namely pivoted in an arbitrary direction with a central axial line of the cap being a center, and can be pivoted to the outer cap **42**. To smoothen this pivoting movement, an insertion end inserted in the receiving part **42***a* of the pivot part **44***a* is formed of a spherical shape, and serves as a spherical bearing.

In this manner, pivoting the inner cap **44** allows the inner cap **44** to incline relative to the central axial line of the cap so as to obtain operations and effects similar to those in the previous embodiments. The receiving part and the pivot part may be formed on any of the outer cap and the inner cap, respectively. Also, the outer cap and the inner cap may comprise a plurality of parts, respectively. In this example, the inside of at least a part of or whole inner cap may be made of a soft material.

The cap structure shown in the above-mentioned embodiments is one of application examples, in which the caps **16**, **30**, and **40** are attached or detached by a remote operation of the knocking operation part **14***b*, and is suitable for such application examples. However, needless to say, the cap structure can be similarly applied to a cap of a type in which the cap is operated directly by hands.

While the principles of the invention have been described above in connection with specific embodiments, and particular modifications thereof, it is to be clearly understood that this description is made only by way of example and not as a limitation on the scope of invention.

What is claimed is:

1. An airtight cap structure having a cap for detachably covering a tip to be used to prevent the tip from drying, wherein the cap comprises an outer cap and an inner cap installed in said outer cap, and the inner cap is mounted to the outer cap so that the inner cap can incline relative to a central axial line of the cap, and the inner cap comes into close contact with the tip or its periphery when the cap

covers the tip used, wherein said inner cap is mounted to the outer cap so has to be rotatable around an axis perpendicular to axial line of the cap.

2. The airtight cap structure according to claim **1**, comprising a pair of shaft parts formed on any one of peripheries of said inner cap and said outer cap and extending in a radial direction, and shaft receiving holes formed on the other of the peripheries of the inner cap and the outer cap and receiving said shaft parts.

3. The airtight cap structure according to claim **1**, wherein said inner cap is mounted so as to be swingable around a annular part formed on the inner periphery of the outer cap.

4. The airtight cap structure according to claim **3**, comprising an annular recess formed on any one of the peripheries of said inner cap and said outer cap, and a projection formed on the other of the peripheries of the inner cap and the outer cap and loosely fitted with said recess.

5. The airtight cap structure according to claim **1**, wherein said inner cap is mounted to the outer cap so as to be pivotable around a central axial line of the cap.

6. The airtight cap structure according to claim **5**, comprising a receiving part formed on any one of peak surfaces of said inner cap and said outer cap, and a pivot part formed on the other of the peak surfaces of the inner cap and the outer pap and pivoted to said receiving part.

7. An instrument comprising: a cap having the airtight cap structure according to claim **1**; an axial sleeve holding a tip; a knocking member installed to the axial sleeve, said knocking member adapted to be knocked in an axial direction to attach and detach the cap from the axial sleeve; and a rotation converting mechanism connecting the cap with the knocking member wherein said rotation converting mechanism moves the cap forward, rotates the cap around an axis parallel to the axial direction, and then moves the cap backward in response to one knock in an axial direction of the knocking member, and every knock of the knocking member, the cap can be switched between a condition that the cap covers the tip, and a condition that the cap exposes the tip.

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